SIMULATION OF SEA LEVEL RISE IN KLANG COASTLINES BY USING ARCGIS

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Peningkatan paras air laut telah dikenal pasti sebagai salah satu ancaman utama terhadap semua hidupan di persisiran pantai dan komuniti di seluruh negara. Peningkatan paras air laut yang ketara boleh menjejaskan kegiatan ekonomi, perdagangan, perlancongan, biodiversiti dan kehidupan seharian. Peningkatan paras air laut juga boleh mencetuskan banjir, hakisan pantai dan bahaya disebabkan angin kencang yang bakal memberikan kesan besar terutamanya terhadap penduduk di kawasan tanah rendah di persisiran pantai. Kajian ini telah dijalankan sebagai salah satu usaha untuk mengenalpasti kawasan berisiko tinggi yang bakal terjejas akibat daripada peningkatan paras air laut pada tahun 2030, 2050 dan 2100. Kawasan yang telah dipilih untuk kajian ini ialah Klang, Selangor. Fenomena air pasang, perubahan iklim global, faktor antropogenik (akibat perbuatan manusia) dan banjir pantai adalah antara faktor berlakunya peningkatan paras air laut. Kajian ini telah mengunakan aplikasi Arc Geographical Information System (ArcGIS) yang merupakan alat berasaskan komputer untuk menjana hasil pemetaan dan menganalisa sesuatu perkara yang wujud atau berlaku di bumi. ArcGIS menjana hasil peta banjir yang diakibatkan oleh peningkatan paras air laut menggunakan data topografi yang diperolehi daripada laman sesawang United States Geological Survey (USGS), data paras air laut daripada National Hydraulic Research Institute of Malaysia (NAHRIM) dan data air pasang daripada National Hydrographic Centre Malaysia (NHC). Pada akhir kajian, ArcGIS akan menyediakan hasil kawasan banjir akibat kenaikan paras air laut. Pada tahun 2030 dan 2050, jumlah kawasan yang banjir adalah sama kerana hanya terdapat sedikit perbezaan kenaikan paras air laut iaitu hanya 0.115 meter dibandingkan dengan tahun 2100 iaitu 0.320 meter. Oleh itu, jumlah kawasan banjir akibat peningkatan paras air laut pada tahun 2100 lebih besar. Kawasan yang berkemungkinan untu banjir di kawasan Klang ialah kawasan yang berkedudukan rendah seperti Pulau Ketam, Pulau Klang, Pulau Selat Gering, Teluk Gong, Pulau Mat Zain dan Port Klang. Pelan mitigatasi telah dicadangkan untuk mengatasi masalah kenaikan paras air laut iaitu pemulihan SAUH dan pemecah air terendam.

ABSTRACT

Sea level rise has been recognized as a major threat to coastal habitats and community worldwide. A significant increase of sea level would hamper the economy, trade, tourism, biodiversity, and livelihood. Sea level rise plays a role in flooding, shoreline erosion and hazard from storm which would give great impact especially to low-lying coastal area. In an effort, this study was carried out to identify the risky locations that were affected in year 2030, 2050 and 2100. The selected area was located in Klang, Selangor coastline. Tide events phenomenon, global climate change, anthropogenic factors and coastal flood were among the factors that contribute to the sea level rise. This study was implemented by using Arc Geographical Information System (ArcGIS) software which was a computer-based tool for mapping and analysing things that exist and events that happen on Earth. ArcGIS would generate the data collected from United States Geological Survey's (USGS) website, National Hydraulic Research Institute of Malaysia (NAHRIM) and National Hydrographic Centre Malaysia (NHC) which were topography Digital Elevation Model (DEM), sea level rise and high tides data. At the end of the study, ArcGIS has provided the result of inundation area due to sea level rise. In year 2030 and 2050, the total inundated area was same because there were only slightly difference in the increment of projection sea level rise which was 0.115 meter compared to year 2100 which was 0.310 meter. Thus, in year 2100, the total inundated area was bigger than the previous year. The potential inundated area in Klang coastline was mostly all the low-lying area such as Pulau Ketam, Pulau Klang, Pulau Selat Gering, Teluk Gong, Pulau Mat Zain and Port Klang. Mitigation plans were proposed to overcome the sea level rise risk in Klang area which were SAUH revetment and submerged breakwater.

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LIST OF ABBREVIATIONS

GIS	Geographical Information System
ArcGIS	Arc Geographical Information System
NAHRIM	National Hydraulic Research Institute of Malaysia
NHC	National Hydrographic Centre Malaysia
USGC	United States Geological Survey
DEM	Digital Elevation Model
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
GoM	Gulf of Mexico
TIN	Triangulated Irregular Network
DTM	Digital Terrain Model
DSM	Digital Surface Model
SRTM	Space Shuttle Radar Topography Mission
SAUH	Simplified Armour Unit 'H' Revetment

CHAPTER 1

INTRODUCTION

1.1 Introduction

Klang was located in the eastern part of the Selangor which was facing the Straits of Malacca. According to the Department of Statistics Malaysia 2010, Klang has 861,189 number of population. Sea level rise has been recognized as a major threat to coastal habitats and communities worldwide (Nicholls *et al.*, 2007; Mohamad *et al*., 2018). A significant increase of sea level would hamper the economy, trade, tourism, biodiversity and livelihood. The height of the ocean surface at any given location or sea level was measured with respect to the surface of the solid Earth.

Sea level could be categorized into two parts which were global sea level rise and relative sea level rise. Global sea level rise was the average height of Earth's ocean combined or relative to the centre of Earth. The consequences of global sea level rise could be even scarier than the worst-case scenarios predicted by the dominant climate models, which do not fully account for the fast breakup of ice sheet and glaciers (Richardson *et al*., 2015). The changes in ocean volumes primarily occurred because of two factors which were ice melting and thermal expansion. Meanwhile, the local or relative sea level was affected by global sea level fluctuations, rise and fall of sea surface, rise and subsidence of land also on the erosion and accretion.

Besides, the probability of sea level to become rise was higher during raining season. The changes in ocean volumes and changes in water storage on land such as dams, wetlands and soil moisture were because of increase in amount of rainfall intensities. The combination of heavy rain and strong winds would make the amount of rainfall intensities increase dramatically and even worse could create a huge sea wave. Sea would overflow due to the gravity forces and this would affect all the low- lying

areas and dry land areas flooded with water. Figure 1.1 shows sea level rise happened at Pantai Kelanang, Banting, Selangor in September 2016 by Kosmo's newspaper. Meanwhile, Figure 1.2 shows the phenomenon of sea level rise at Kampung Sungai Meriam, Kedah in September 2016 by mStar's newspaper and Figure 1.3 shows the sea level rise at Sungai Petani, Kedah by The Malaysian Times, on October 2016.

Figure 1.1 Sea Level Rise at Pantai Kelanang, Banting, Selangor

Source: Kosmo (2016)

Figure 1.2 Sea Level Rise at Kampung Sungai Meriam, Kedah

Source: mStar (2016)

Figure 1.3 Sea Level Rise at Sungai Petani, Kedah

Source: The Malaysian Times (2016)

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